Techbridge

Engineers to the Rescue

A Girl's Extreme Survival Guide

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We thank the leadership at the Noyce Foundation and the Gordon and Betty Moore Foundation for recognizing Techbridge's potential to impact girls beyond those in our local community. These Foundations' generous support of this project made the partnership with Girl Scout Councils possible.

We would like to acknowledge our partners who reviewed the lessons, piloted the activities, and provided feedback. We thank Cary Sneider and Lisa Regalla for their thoughtful reads of our lessons and suggestions for making the science content accurate and accessible for Girl Scouts and the adults who work with them. Our advisory team including Faith Brown, Jean Fahy, Randy Freedman, Melissa Koch, Diane Matt, and Karen Peterson offered guidance to support our training for leaders.

The Techbridge staff demonstrated tireless creativity and flexibility while developing and testing these programs. Thanks to Maria Anaya, Megan Davis, Jennifer Diaz, Jennifer Joyce, Linda Kekelis, Molly Larkin, Lulu McCourt, Martha Pena, and Jennifer Wei, with the assistance of Eli Leonardo, Jennifer Tai and Vicki Tu.

Our friends at the Girl Scout councils of Northern California (especially troops 60021, 60656, and 60688), Central Texas, West Central Florida and Central Maryland, piloted early versions of the activities and offered suggestions that helped improve the program boxes. Our partnership with Girl Scout councils embodies the best in collaboration. We have shared resources and learned so much from teaming up on this project. Together we worked to inspire girls to change the world through engineering and science.

Engineers to the Rescue
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About Techbridge

"Boring, nerdy, and only for boys." Some girls may think of engineering in those terms, but not the girls participating in Techbridge. They say, "I learned that this science thing is very fun and educational at the same time. I LOVE IT!" and "I learned that engineering is not just for men."

Techbridge is a leader in providing girls with firsthand experience working as engineers—from designing toys and building turbines, to meeting professional engineers who help make the world a better place.

Techbridge brings together best practices and lessons learned for partners and offers curriculum that builds on girls' interests and expands their career options. We have seen first-hand the impact that role model visits and field trips can have. We offer training and resources to youth-serving adults to create positive experiences for girls.

The Techbridge program reaches out to girls in under-served communities and offers after-school and summer programs with hands-on projects and career exploration. Techbridge has served over 3,000 girls in elementary, middle, and high schools in Oakland, California and surrounding communities since its start in 2000. The program has been shown to increase girls' confidence, build skills, and promote interest in careers in engineering, science, and technology.

In order to bring a Techbridge experience to girls across the country, we are partnering with Girl Scout councils. The Techbridge team has developed programs-in-a-box that include all the activities and materials you will need to introduce girls to the wonders of engineering and science. The Girls Go Techbridge program-in-a-box includes the leader guide you have in your hands, and the box of materials in front of you, ready for a group of ten girls to dive in and enjoy.

We invite you to partner with us to bring engineering and science to girls in your community. Together we can inspire a girl to change the world.

For more information, visit www.techbridgegirls.org.

Engineers to the Rescue: Suggested Schedule

<table>
<tr><th>Time</th><th>Session 1</th><th>Session 2</th><th>Session 3</th><th>Session 4</th></tr>
<tr><td>:00</td><td>Pre-Surveys
(if applicable)</td><td rowspan="6">Activity:
Clean This Water</td><td rowspan="2">Career Activity:
Your Career Card</td><td>Icebreaker:
Fractured Facts</td></tr>
<tr><td>:10</td><td>Icebreaker:
Rescue Introduction</td><td rowspan="5">Activity:
Car to the Rescue</td></tr>
<tr><td>:20</td><td rowspan="2">Icebreaker:
Design Your Tool</td><td rowspan="5">Activity:
Give Me Shelter</td></tr>
<tr><td>:30</td></tr>
<tr><td>:40</td><td rowspan="6">Activity:
Wind-Powered Crank</td></tr>
<tr><td>:50</td><td rowspan="3">Career Activity:
Tune in Techbridge</td></tr>
<tr><td>1:00</td><td></td></tr>
<tr><td>1:10</td><td>Icebreaker:
Girl of the Year</td></tr>
<tr><td>1:20</td><td></td></tr>
<tr><td>1:30</td><td></td><td>Post-Surveys</td></tr>
</table>

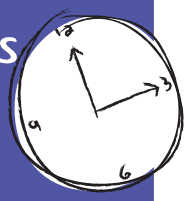
Engineers to the Rescue: Alternative Schedules

	6 Hours	4.5 Hours
:00	**Icebreaker:** Rescue Introduction	**Icebreaker:** Rescue Introduction
:10	**Icebreaker:** Design Your Tool	**Activity:** Wind-Powered Crank
:20	**Activity:** Wind-Powered Crank	
:30		
:40		
:50		
1:00		
1:10		**Activity:** Clean This Water
1:20	**Activity:** Clean This Water	
1:30		
1:40		
1:50		
2:00		
2:10		**Activity:** Give Me Shelter
2:20	**Career Activity:** Tune in Techbridge	
2:30		
2:40		
2:50	**Activity:** Give Me Shelter	
3:00		
3:10		**Activity:** Car to the Rescue
3:20		
3:30		
3:40		
3:50		
4:00	**Lunch**	**Career Activity:** Tune in Techbridge
4:10		
4:20		**Icebreaker:** Girl of the Year
4:30	**Activity:** Car to the Rescue	
4:40		
4:50		
5:00		
5:10		
5:20		
5:30		
5:40		
5:50	**Career Activity:** Your Career Card	
6:00		

Engineers to the Rescue: Introduction

4 Suggested Sessions

approximately 1 hour and 30 minutes each



Skills:

- Brainstorming
- Communication
- Teamwork
- Critical & Creative Thinking

The Scenario:

You're on a camping trip with your Girl Scout troop at Yellowstone National Park. Your first day at Yellowstone was incredible; you hiked all morning, saw Old Faithful in the afternoon, and sang campfire songs under the stars. You also visited the Visitor's Center, picked up a brochure, and met a park ranger. You learned that Yellowstone is situated on a bed of lava, and that minor earthquakes are frequent.

Although scientists didn't predict it, there was an earthquake which shook your tents for two minutes overnight. Unfortunately, this natural disaster has broken the water pumps, and disrupted the generators in the park. To make matters worse, your cell phone battery is dead and you can't call for help. The worst part is your animal-proof food box fell down a ravine. You're hungry!

The good news is that your troop is safe, everyone is in good spirits, and women from the Society of Women Engineers (SWE) are on a leadership retreat—they are your neighbors at the campground! They have a lot of knowledge to offer as you rebuild your campground. Check out the backs of the career cards to hear from the SWE team.

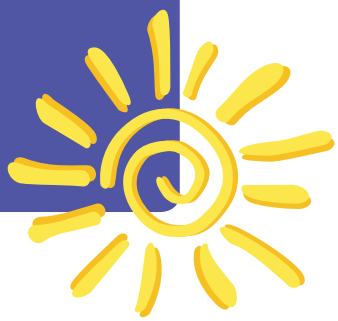
As a troop, you must develop a wind-powered crank to lift your food box, create a water filter to clean water for drinking, build a shelter to withstand any aftershocks, and design a car prototype that will make it over the terrain to deliver your message to potential rescuers. You've got common sense, science smarts, and a group of skilled engineers to help you.

Good luck!

Meet the SWE* Team!

- Environmental Engineer, Cari Ishida
- Geologist, Jeanette Hummel
- Civil Engineer, Melanie Lapointe
- Mechanical Engineer, Judy Lee
- Structural Engineer, Kittrina McCourt

* Society of Women Engineers

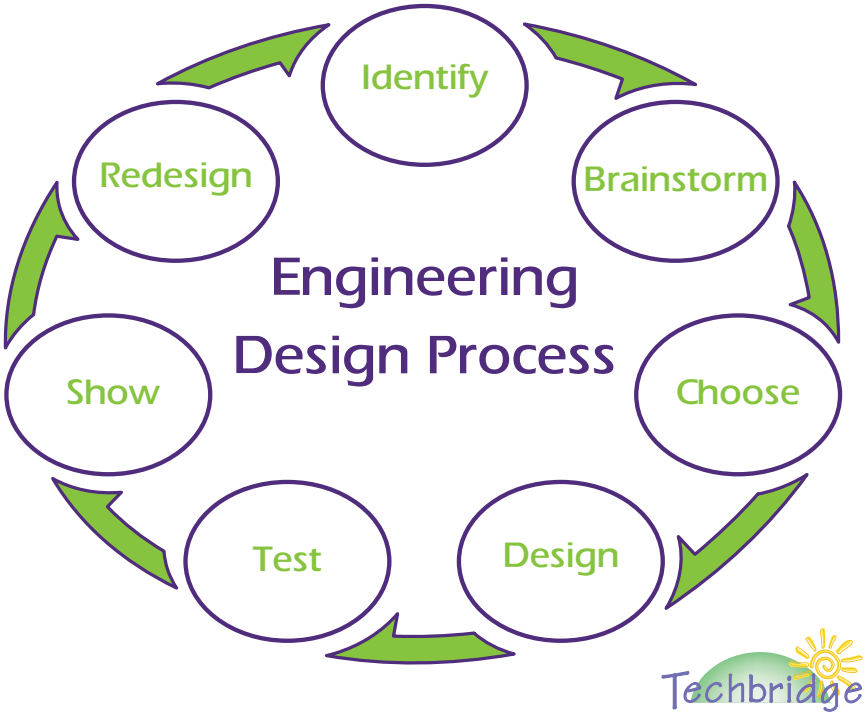


Engineering Design Process

The Techbridge **Engineering Design Process** is a never-ending cycle of creativity. With each of the hands-on activities in this guide, we encourage you to lead girls to identify and talk about where they are in the design cycle. Growing awareness of the design process helps girls strengthen their outcomes, whether it be a hand-made product or a presentation in front of a group.

The design process encourages girls to both "try, try again" and recognize that "two heads are better than one." Engineers, and everyone from kids to professionals, use these steps to reach their desired result. We knew this was an effective tool when one Girl Scout remarked that she used the **Engineering Design Process** when writing and revising a paper for English class, and to persuade her parents to get a later curfew!

As the leader, you'll have to know when it's time to stop, but the more opportunities you allow girls to reflect, redesign, and repeat the design process steps, the better the experience for all. We recommend you display the supplied **Engineering Design Process** poster throughout these activities for easy reference.



Recommendations:

Throughout this project, emphasize the **Engineering Design Process** and the steps necessary to make an innovative, well-functioning design.

Girl Scout Leadership Experience

In 2008, Girl Scouts of the USA introduced fifteen Leadership Outcomes to help leaders create and recognize a successful Girl Scouting experience. You know your girls are enjoying a quality Girl Scout activity when an out-of-school experience is girl-led, experiential, and cooperative. You see that your girls are leaders when they:

Discover…

- Girls develop a strong sense of self
- Girls develop positive values
- Girls gain practical life skills
- Girls seek challenges in the world
- Girls develop critical thinking

Connect…

- Girls develop healthy relationships
- Girls promote cooperation and team building
- Girls can resolve conflicts
- Girls advance diversity in a multicultural world
- Girls feel connected to their communities, locally and globally

Take Action…

- Girls can identify community needs
- Girls are resourceful problem solvers
- Girls advocate for themselves and others, locally and globally
- Girls educate and inspire others to act
- Girls feel empowered to make a difference in the world

We are proud that Techbridge's hands-on activities meet many of the Girl Scout Leadership Experience (GSLE) outcomes. Girls gain practical life skills and develop critical thinking abilities as they work through design challenges in our programs-in-a-box. By testing and redesigning their products, working through the **Engineering Design Process**, girls thrive on challenges, conquer doubts, and gain confidence and new perspective.

Girls develop healthy relationships, learn to cooperate, and resolve conflicts as they share, brainstorm, and negotiate in teams and pairs during Girls Go Techbridge activities. To build connectedness with your community, we encourage you to invite role models in engineering to interact with your girls. Remind your guest engineers to share that they are members of the very same community as your girls, and that together we can all be problem-solvers for the issues facing our world.

We hope, through the reflection and active questioning built into the Girls Go Techbridge activities, you will lead your girls to identify community needs, educate and inspire others, and feel empowered to make a difference in the world. While our hands-on-activities are presented in the context of having fun in an informal learning environment, there are real-world applications. With the skills and concepts learned by working through this program-in-a-box, girls gain the tools to make the world a better place.

Our mission at Techbridge is to inspire a girl to change the world. Thank you for sparking the fire for change.

Leader Tips

Tips on Grouping

Throughout the Activities and Icebreakers girls are often asked to work in groups. Below are a few tips to help you get started.

- Before breaking the girls into groups, consider having the girls brainstorm rules or norms for their behavior. They can refer to the Girl Scout Promise and Laws for ideas.
- Consider the relationships between the girls. How well do they know each other? Do they get along? Are some more familiar with the material or topic? This will help you create groups that are well balanced.
- Groups or teams larger than four can present problems for participation and interaction. Suggested group sizes are noted with each activity.
- To give everyone the opportunity to participate, consider assigning roles to each girl within the group. Possible roles include: group leader, reporter, recorder, set-up, clean-up, facilitator, manager. When assigning roles, make sure each girl is aware of the role's responsibilities. If possible across the activities, change it up so that girls are able to experience more than one role.
- Avoid rushing to rescue when a group is stuck, or providing "the answer." Let them discuss and come to their own conclusions. If you are talking, the girls have less time to talk and work together.
- Get involved when the group is hopelessly off task, when the group does not seem to understand enough to get started, when the group is experiencing serious personal conflict, or if the group can't organize themselves.
- To know if your groups are working, as you observe, check to see if the girls are: asking questions, listening to each other, helping each other, and explaining by telling how and why.

Tips on Facilitating Discussions

Discussions are an opportunity for girls to process and extend the different ideas they encounter throughout the activities. Below are a few tips to consider before beginning a discussion.

- Consider the physical set-up in your room. Can the girls see each other?
- Review and enforce the behavioral "norms" or rules established by the group.
- Listen well. Validate questions by either expanding on them or challenging them, and encourage girls to challenge each other in a productive and positive way.
- Allow for wait time when you ask a question. Give girls time to respond. To formulate thorough responses, they need time to process the question.
- Offer different options for participation. Letting girls turn in written responses often helps shyer girls.
- Pause. Give the girls a few minutes to put together a response. Let girls discuss in small groups and then present their thoughts to everyone.
- Prompt girls with a variety of questions that require different levels of thinking.
    * Some questions ask for basic knowledge and comprehension of the activity. For example, What differences exist between...? or Can you name the...?
    * Some questions ask girls to apply or analyze the relationship between different ideas. For example, What factors would you change if...? or What are some of the problems of...?

  * Some require girls to synthesize or evaluate concepts to new or different situations. For example, Can you see a possible solution to...? or How effective are...?
- To know if your discussions are working, check to see if the girls are asking for others' opinions, listening, thinking or reflecting on what has been said, giving reasons for their responses, and allowing everyone to contribute.

Keeping Girls Engaged

Programs-in-a-box are designed to be girl centered. Keeping your activity on track **and** the girls engaged is critical to the success of the activity and will help with learning, retention, and enthusiasm for the other activities. Down time during an activity can lead to girls getting off track. To keep girls engaged, try the following techniques:

- Mental warm up. In addition to using an icebreaker in the program, take a few moments to do a yoga move, a song, or group rhythm using clapping or stomping, etc.
- Know your girls! Who works well together? Who doesn't? Who will struggle with some of the content and who will approach it enthusiastically? Thinking about these different ideas for a few minutes before you begin can help you avoid problems getting started and keeping girls motivated. One of our goals is to promote cooperation and team building.
- Quieting girls down. Have the girls do a quick write, think-pair-share, journal, or draw for a minute. You could also use the Girl Scout tradition of raising your hand and standing silently to get attention. The next person does the same, and it continues until silence spreads throughout the group. The last person not paying attention is soon the only one talking.
- Know your activities. It is vital that you closely read over the activity. When you know what you have to do, there is little confusion and less down time for the girls.
- Ask three then me. This means that the girls ask three peers before coming to you for help. The result is that the girls are more likely to work though a particular problem on their own. They are the ones doing the work—make them accountable.
- Assign girls tasks. Let the girls read the introduction while you set up. Keeping the girls busy and involved in the task allows them to maintain interest and ownership in the activity.
- Heads up! When engaging hesitant or shy girls consider your grouping and let them know a little ahead of time that they will be asked to do something. We want to encourage participation through success!

Tips on Brainstorming

Many girls are familiar with the brainstorming process, but have difficulty getting started or will want to move ahead with the first idea they think of. To encourage girls to generate as many ideas as they can, consider the following tips before you begin.

Begin with the T.E.C.H. guidelines for Brainstorming.

T – Think of many ideas. Write down all ideas, no matter how wild. The more ideas, the better!

E – Everyone's ideas are good. Work as a team and respect every idea. Everyone should participate. Keep the tone positive!

C – Creativity. Be creative and spontaneous. There are no wrong answers and lots of possible solutions.

H – Have an open mind. Consider your own ideas and the ideas of others.

To get their brainstorming going:

- Use a visual. Have the girls examine the materials they'll be using.
- Sketch. Suggest they do rough sketches.
- Think/pair/share. When brainstorming in pairs, have the girls think individually about the topic for a minute, pair with their partner to consider all ideas, and finally share with the group.
- Free writing. Some girls are more comfortable writing their ideas down in a list.
- Clustering/mapping/webbing. This technique focuses on the relationship between different characteristics or traits of the topic.
    - Begin by writing the topic in the middle of a page. From the concept word, write as many related concepts or terms as you can associate with the central topic. If you run out of similar concepts, write down opposites, but try to keep writing and associating. As you jot down ideas, connect them with lines to show how they relate to each other.

Parent Resource Handout

This handout is designed to give parents some tips on how to support and encourage their daughters outside of the program boxes. Please send copies of this *Parent Resource Handout* home.

Encouraging Girls in Science and Engineering

You can make a difference in a girl's future! If you're looking for an activity to do with your daughter, try one that encourages the skills she will need to pursue science, technology, or engineering. Here are some ideas that build on the concepts explored in this program-in-a-box.

1. Allow your child to tinker with tools around the house. Given permission, you will be surprised to see what she comes up with! Certain appliances, like hair dryers, are safe to take apart once the power cord is cut off. See if you can figure out how the different parts work together. Check out www.howstuffworks.com.
2. Get your daughter a kit to build. You can find mechanical animals and other kits that require following schematic drawings and using tools to build something exciting. Your daughter will gain confidence in building and learn how moving toys work.
3. Buy your daughter a set of K'NEX®. These building blocks allow for unlimited imagination when building projects and structures.
4. Check out a book about Rube Goldberg at your library, or look him up online. He was the father of interconnected machines now called Rube Goldberg machines, where you start the process at one end, and watch a fascinating series of events that result in a specific action at the end. The game Mouse Trap® is one example. Try building one yourself with recycled materials found around the house.
5. Next time you ride a plane or train, ask the conductor or attendant if you can take a peek into the cockpit or control booth. You might be surprised what they can show you.
6. Go dark for a day and count how many electrical conveniences you take for granted.
7. Visit your utility company's website and see how much of their energy is generated by wind, solar, or other alternative sources.
8. Make a survival kit at home for earthquakes, hurricanes, tornadoes, snowstorms, or your disaster of choice.
9. Host a slumber party for your daughter and her friends to work on a project inspired by the PBS TV show, SciGirls. For inspiration, visit http://pbskids.org/scigirls/.
10. Turn off the TV and spend a day playing board games and puzzles. Look for games that promote problem-solving and spatial skills, such as jigsaw puzzles, checkers, chess, and tangrams.
11. Give a girl a biography of a female role model. We recommend the *Women's Adventures in Science* series, available at www.nap.edu/catalog/was/ or at your local library.

Techbridge

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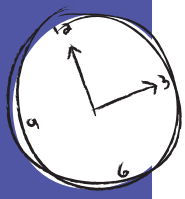
Planning a Role Model Visit

Hands-on projects can spark an interest in science, technology, or engineering, but on their own they may not lead to a career interest in these fields. Role models can inspire girls and help them make informed decisions about their future. Interactions with role models require the right combination of career guidance and social engagement. The key is for role models to be personal and passionate while communicating how their work matters. A hands-on activity that offers a snapshot of their work will engage and inspire your girls.

Sample Schedule

15 minutes	Welcome and Icebreaker
10 minutes	Introduction by Role Model
45 minutes	Hands-on Activity
15 minutes	Wrap-up and Q&A



Finding role models:

- Contact your local Girl Scouts STEM coordinator for role model contacts. They may have contacts at organizations such as the Society of Women Engineers that can provide role models in your area.
- Ask your friends and contacts for leads.
- Check with science teachers who may have contacts.
- Is there an Expanding Your Horizons program in your community? You will find great role models there.
- Recruit role models from local businesses or universities. University students can make great role models too, especially for older girls thinking about college.
- Recruit a diverse group of role models (especially individuals that reflect the diversity of your girls).
- Be creative!

Tips:

1. Share our role model resource guide ***Get Involved…Make a Difference*** and toolkit that include suggested activities, questions, and other resources. http://www.techbridgegirls.org/rolemodels.aspx
2. Help your role model start with an icebreaker. We recommend using ***Put Yourself on the Line*** (from the online toolkit) so the role model can introduce it and then complete the worksheet using her current workspace.
3. Encourage role models to start with a personal story to help them connect with your girls.
4. Invite role models to share their passion for what they do. When they get excited, your girls will, too.
5. Encourage role models to explain why their work is important and how it helps the world.
6. Encourage role models to talk about more than just their job. Invite them to talk about hobbies, family, and friends which will help dispel stereotypes.
7. Role models can help by offering guidance such as the importance of taking advanced math and science classes, finding summer classes or internships, and getting good grades.
8. Make sure your girls send thank-you notes to role models after the visit.

Engineers to the Rescue: Materials

Sessions	Quantity	Consumable Materials	Non-Consumable Materials
1: Rescue Introduction	5		Yellowstone brochures
	1		Engineering Design Process poster
1: Design Your Tool	5	sheets of paper	
	10	paper clips	
	20	toothpicks	
	5	drinking straws	
	5	business size envelopes	
	5		pencils
	1		pencil sharpener
	1		roll of masking tape
1: Wind-Powered Crank	1	spool of string	
	1	roll of masking tape	
	1	box of staples	
	1	box of paper clips	
	10	spools	
	10	paper plates	
	10	cardboard scraps	
	10	dowels	
	10	plastic cups	
	10	paper cups	
	1	roll of duct tape	
	5	dixie cups	
	30	glue sticks	
	40	popsicle sticks	
	10	straws	
	100		paper clips
	1		stapler
	5		extension cords
	5		hot glue guns
	5		box cutters
	1		blow dryer
	1		stop watch
	1		tape measure
	5		scissors
	5		Civil Engineer career cards
	1		Engineering Design Process poster

Engineers to the Rescue: Materials

Sessions	Quantity	Consumable Materials	Non-Consumable Materials
2: Clean This Water	10	Clean This Water handouts	
	5	cups of gravel	
	5	cups of sand	
	30	coffee filters	
	40	cotton balls or gauze	
	2	cups of activated carbon (charcoal)	
	15	scraps of cotton or denim cloth	
	1	piece of styrofoam	
	3	plastic spoons	
		soy sauce	
		dried beans	
		organic potting soil	
		vegetable oil	
	10		pencils
	1		measuring cup
	5		utility knives
	5		scissors
	1		2 gallon bucket
	5		Environmental Engineer career cards
	1		Engineering Design Process poster
2: Tune in Techbridge	1	roll of aluminum foil	
	45	toothpicks	
	30	popsicle sticks	
	1	roll of masking tape	
	3		pens
	3		golf balls
	1		measuring tape
	3		sets of career cards

Not Provided!

Leaders must remember to collect ten 20 oz. plastic bottles for Session 2 activity Clean This Water.

Engineers to the Rescue: Materials

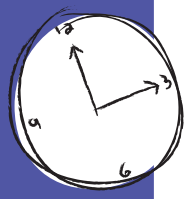
Sessions	Quantity	Consumable Materials	Non-Consumable Materials
3: Your Career Card	10	blank career cards	
	10		pencils
	2		sets of 5 role model career cards
	2		boxes of permanent markers
3: Give Me Shelter	24	skewers	
	6	feet of twine	
	100	plastic leaves	
	3	sheets of construction paper	
	1	bag of soil	
	1	bag of ash	
	1	bag of sand	
	1	bag of pea gravel	
	1	package of clay	
	10	sheets of scratch paper	
	1	roll of masking tape	
	2		sets of measuring cups
	1		extension cord
	1		Engineering Design Process poster
	1		stop watch
	1		spray bottle
	1		blow dryer
	5		rulers
	5		round pie pans
	1		rectangular pie pan
	1		bag of golf balls
	5		pencils
	5		scissors
	5		Structural Engineer career cards
	5		Geologist career cards
	5		Soil Types handouts
	1		set of Job Description posters

Engineers to the Rescue: Materials

Sessions	Quantity	Consumable Materials	Non-Consumable Materials
4: Fractured Facts	1		set of Q&A cards
4: Car to the Rescue	40	wheels	
	10	skewers	
	15	straws	
	15	spools	
	10	pieces of foam board	
	10	pieces of cardboard	
	40	popsicle sticks	
	10	hot glue sticks	
	1	roll of duct tape	
	1	roll of scotch tape	
	100	rubber bands	
	5		hot glue guns
	5		scissors
	1		measuring tape
	5		Mechanical Engineer career cards
	1		Engineering Design Process poster
4: Girl of the Year	10	Girl of the Year praise pages	
	1		set of markers
	10		pencils
	1		set of career cards

Rescue Introduction

15 Minutes



Materials:

Per Troop

- Yellowstone Brochures
- Engineering Design Process poster

Grouping: Whole Group

Introduction: In this activity, you will introduce girls to the scenario of the Engineers to the Rescue program-in-a-box. They will examine the Yellowstone brochure, play a memory game, and sing a camping song to help them think about different things they might pack for a camping trip.

Objectives: As a result of this activity, the girls will be able to:

- Work as a team
- Understand the scenario of the campsite
- Reinforce the idea that engineers are creative problem solvers

Directions:

1. **Arrange** the whole group of girls in a circle.
2. **Distribute** the Yellowstone National Park brochures and ask the group to spend a few minutes reading the brochure.
3. **Ask** each girl to share something interesting she read or saw in the brochure with the group.
4. **Review.** Make sure girls know that Yellowstone, the first national park, is known for the geyser "Old Faithful," lots of bison, moose, and the endangered grizzly bear. There are park rangers patrolling to help keep the camp secure and enjoyable. Note that the "Buffalo Ridge" campground is the imaginary setting of our program's design and survival challenges, and is therefore fictitious. The campground is on a steep hill, and there's a ravine at the edge of camp site.

Option 1 (This is helpful if your girls have not been camping and need to warm up their imaginations for the icebreaker *Design Your Tool*.)

A. **Introduce** this memory game to help girls think about the kinds of equipment and resources they will have when camping.

B. **Explain** that the first girl says the sentence "I'm going camping in Yellowstone and I'm going to take…" She must finish the sentence with one item that she considers a camping necessity.

C. **Repeat.** The girl on her right will repeat what the first girl said, and then tag on her own camping item.

D. **Play.** The game continues until the last girl repeats the entire group's packing list before she adds her own camping item.

Yellowstone Brochure

The Wonders of Yellowstone Park

Yellowstone National Park was the first national park to be established in the United States. Since 1872, visitors from all over the world have marveled at Yellowstone's natural wonders.

Old Faithful, one of the park's most breathaking features, is just one of 300 geysers in the park. Look deeper into the park and you will find a large active volcano and natural hot springs. There are approximately 10,000 different natural water features all over the park.

The volcanic history of Yellowstone has made the geology of the park vastly unique. Because of this, the park is prone to having 1,000 to 3,000 earthquakes each year! Don't worry, many of these are too small to be felt.

After millions of years of forces, like glaciers and volcanic eruptions, changing the landscape of Yellowstone, the park is still transforming under everyone's feet. Don't miss out on the

incredible views from the Grand Canyon of the Yellowstone River. Come back to Yellowstone in another 50 years to see what else has changed.

For more information about Yellowstone, visit one our visitor centers or museums. There is something for everyone here at Yellowstone. Enjoy your visit!

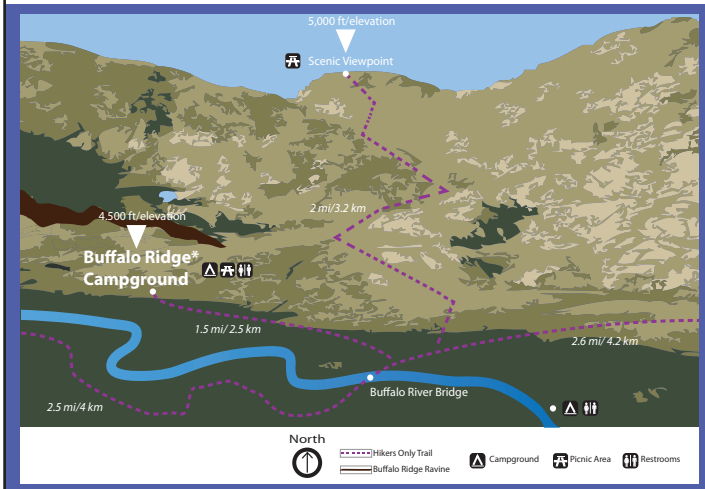
Yellowstone National Park
P.O. Box 168
Yellowstone, WY 82190
www.yellowstone.net

*Techbridge fictional campground

Girl's Guide to Buffalo Ridge* Campground

Yellowstone National Park

Buffalo Ridge - Yellowstone National Park



About Buffalo Ridge

Buffalo Ridge Campground is a great place to experience sun, water and great scenery Yellowstone is known for. This campground sits 500 feet below the peak of a great scenic viewpoint at 4,000 feet elevation. Take a short hike up the mountain to get great views of the valley below. If you are lucky, you might see some of the wildlife roam nearby.

Looking to cool off? Enjoy a refreshing dip in the shallow river near camp. This campground is also equipped with picnic tables and a toilet. Are you looking for more adventure? Gaze down a ravine near the edge of camp. Just don't get too close as the ravine is 50 feet deep.

This campground is off the main trail, so you will encounter very few people during your stay. It is a perfect spot to get peace and quiet. Remember to be safe and enjoy all that Buffalo Ridge at Yellowstone has to offer!

Animals at Yellowstone

Who are Yellowstone's most recognizable tenants? Bison, bears, and moose of course! Yellowstone is home to different mammals, birds, reptiles and fish. Here are some facts on some of our most famous animals.

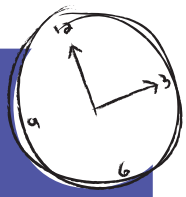
- There are approximately 2500 bison at Yellowstone.
- Moose are the largest members of the deer family, and are plentiful at the park. They enjoy plunging into lakes to feed on the plants underwater.
- Black bears are omnivores. They like to eat meat, fruit and grass.
- Grizzly bears are endangered. More than 500 grizzlies reside at Yellowstone.

Even though these animals seem calm, remember that they are wild, and they can harm humans. Be sure to store your food in sealed containers and in a safe place.

Buffalo Ridge - Yellowstone National Park

*Note that Buffalo Ridge is a fictional campground and this brochure has been designed for this program.

Goin' On a Camping Trip



10 Minutes

Grouping: Whole Group

Option 2 (This is helpful to reinforce the setting and careers featured in this program.)

A. **Tell** the girls to repeat each phrase. The leader and girls should continuously be slapping thighs then clapping hands throughout in a slow, steady beat.

B. **Act.** The leader can add motions as she feels necessary throughout the song. The motion order is thigh, thigh, clap, clap.

Chant Lyrics:

Chorus:
Were goin' on a camping trip
We're gonna go to Yellowstone
There's moose and bear and buffalo
(motion hands as moose, bear claws)
I'm excited! Are you?

Let's get on our backpacks. *(put arms through backpack motion)*
Roll up our sleeping bags *(do rolling motion)*
We gotta be careful
Did you forget the animal-proof food box
I'm not scared! Are you?

Chorus:
Were goin' on a camping trip
We're gonna go to Yellowstone
There's moose and bear and buffalo
(motion hands as moose, bear claws)
I'm excited! Are you?

Walk quietly through the grassy fields *(pretend to quietly walk)*
Hop in the canoe
Paddle down the river *(paddle with arms)*
Look, it's Old Faithful *(point and say "gush!")*
Those geysers sure are hot *(fan yourself)*

Alright, let's keep hiking *(move arms like you're walking hard)*
Up on the hill *(whew!)*
This looks perfect

Let's set up the tent *(make arms in a triangle overhead)*
There's a ravine over there, a great big ditch!
Don't walk to the edge
I'll put the food box here to remind us
Okay, time for dinner *(yum!)*
I'm hungry! *(hands on stomach)*

Chorus:
Were goin' on a camping trip
We're gonna go to Yellowstone
There's moose and bear and buffalo
(motion hands as moose, bear claws)
I'm excited! Are you? *(pointing at each other)*

Earthquake!!!! *(slap legs or pound the ground)*
Did you feel that?
Sure did!
Oh my goodness! *(hands on face)*
Our food box fell down the ravine! *(point to ground)*
Let's get some water *(turn spigot)*
Uh-oh, our pumps are broken
I have an idea
Let's call for help *(hold phone up to ear)*
Uh-oh, our cell phones are dead
Maybe we should just go to bed
Uh-oh, our tents are broken *(hold arms overhead and let them collapse)*
What are we going to do?! *(put hand up to forehead like you're wailing!)*

Goin' On a Camping Trip

Chorus:
We're goin' on a camping trip
We're gonna go to Yellowstone
There's moose and bear and buffalo
(motion hands as moose, bear claws)
I'm excited! Are you? *(pointing at each other)*

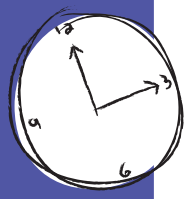
Okay, I have a plan
Let's think like Engineers
You be a **Mechanical Engineer**
I'll be an **Environmental Engineer**
Now we need a **Civil Engineer**
And you can be a **Structural Engineer**
And she can be a **Geologist**
Now we have everyone we need.

Alright, here's what we need to do:
Raise up our food outta that ravine
Filter our water so it's all clean
Send a message that we're a-okay
Build a sturdy structure to keep the rain away
We're goin' on a camping trip!
And as problem-solving engineers, there's
nothing we can't do.

Design Your Tool

15 Minutes

+ 5 minutes preparation time



Materials:

Per pair

- pencil/pen and paper
- 2 paper clips
- 4 toothpicks
- 1 drinking straw
- 2-inch strip of clear tape
- 1 business size envelope
- 3-inch piece of masking tape

Grouping: Pairs

Introduction: In this activity, girls will work in pairs to design a tool prototype that will be helpful in a camp setting.

Objectives: As a result of this activity, the girls will be able to:

- Work effectively with a partner on a task
- Work within a tight deadline

Directions:

1. **Brainstorm** with the group different tools they may need when they are camping at Yellowstone National Park.
2. **Distribute** one envelope with the materials inside and three inches of masking tape to each group.
3. **Inform** the girls they have seven minutes to build one tool they will need when they are camping as a group in Yellowstone.
4. **Allow** three minutes to prepare a thirty-second commercial to advertise the product. If time permits, encourage the girls to come up with catchphrase(s), logos, posters, and music.
5. **Present** the commercial to the whole group, demonstrating how the tool could be helpful.

Reflection:

6. What was most challenging about this project?
7. What considerations did you think about when coming up with your ideas for your tool?
8. What steps in the **Engineering Design Process** did you use?

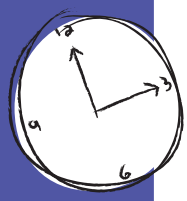
Note:

This activity is adapted from Tribes: A New Way of Learning and Being Together by Jeanne Gibbs.

Wind-Powered Crank

60 Minutes

+ 10 minutes preparation time



Materials:

Per Group

- string
- paper clips
- tape
- stapler & staples
- straws
- 2 spools
- paper plates
- cardboard scraps
- box cutters
- glue guns and glue
- dowels
- duct tape
- dixie cups
- various sized paper and plastic cups
- scissors
- popsicle sticks
- blow dryer
- stop watch
- tape measure
- extension cords
- masking tape
- Civil Engineer career cards

Grouping: 2 - 3 Girls per group

Introduction: In this activity, girls will create a working wind-powered crank. The crank must lift twenty paper clips (representing the weight of the food box) 50 cm off the ground using a blow dryer as its wind source.

Objectives: As a result of this activity girls will be able to:

- Understand the concept of wind power
- Work effectively as a team
- Work with and maximize limited resources
- Describe how wind energy can be used to power machines

Science Behind It:

A windmill is a machine that runs on the energy generated by a rotating wheel of adjusted blades. Windmills use wind power for a variety of uses including pumping water, grinding corn, or cutting lumber. They are the predecessors of modern wind turbines, and were used as far back as 2000 B.C. in China to propel boats.

A modern wind turbine is a device that derives energy from the wind and converts it into electricity. The energy in the wind turns two or three propeller blades (like the ones on a plane) around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. Turbines are built in places like deserts and valleys where wind is common. Wind energy is a clean and renewable energy source. Unlike fossil fuels, wind energy doesn't cause by-products like greenhouse gases or other pollutants.

Preparation:

- **Cut** the string into 50 cm sections.
- **Prepare** the materials for each group.

Wind-Powered Crank

Opening (5 minutes):

1. **Show** the wind crank (and buffalo) illustration and read the scenario to the girls:

   After the big quake shook the campground, our group realized our buffalo-proof food box fell into a deep ravine. Melanie, from SWE, suggested using a wind-powered crank as a way to lift the food box to get our dinner. Good luck!

2. **Ask** a volunteer to read the back of the **Civil Engineer** career card. Ask if someone can explain or act out what the axle is. Explain to the girls that they will be challenged to build a wind-powered crank that lifts twenty paper clips in a Dixie cup off the floor to the surface of the table (approximately 50 cm off the ground).

3. **Explain.** They will use a blow dryer as a wind source and be timed. The group with the wind-powered crank that lifts the paper clips the fastest are the Wind Champions!

4. **Lead** a discussion about wind power and its potential for providing energy.

   ❍ What effect does the wind have on objects?

   ❍ How can we capture wind energy? *(Sailboats, pinwheels, wind turbines, etc.)*

Brainstorm (10 minutes):

5. **Arrange** the girls into groups of two or three and show them the materials they have to work with.

6. **Note.** In order for the girls to have a successful wind-powered crank, they need the following:

   - The string needs to be wound around a rotating part (dowel or spool) of the wind-powered crank.
   - The blades need to be large and sturdy enough to maximize the amount of wind that is captured.
   - Whatever part the blades are attached to needs to rotate freely.

7. **Draw.** Have the girls draw a diagram of a wind-powered crank they would like to build. Discuss the following questions:

   ❍ How can you apply what you learned about wind to your wind-powered crank?

   ❍ Explain how you will capture energy from the wind to power your crank.

   ❍ How will you lift your cup using a rotating spool?

Note:

This activity is adapted from Environmental Science. Austin: Holt, Rinehart, and Winston, 1996.

Wind-Powered Crank

Hands-On (35 minutes):

8. **Allow** twenty to thirty minutes to build the wind-powered cranks.

9. **Test.** As groups finish they can test their wind-powered crank. Follow these rules:

   - Use a blow dryer on the "high" setting to simulate wind.
   - You may control the direction and position of the blow dryer, but you must not let the blow dryer touch your wind-powered crank.
   - Do not touch the wind-powered crank once the testing has started.
   - Start with the Dixie cup resting on the floor and leave slack in the string that is connected to the wind-powered crank.

10. **Compare** the time it took for each of the wind-powered cranks to lift the paper clips after each group has tested their wind-powered crank.

Note:

The girls will be using glue guns. Stress that they get VERY hot and the glue can burn. Use craft sticks or other objects to press down the glue rather than your fingers to help prevent burns.

Reflection (10 minutes):

11. **Lead** a discussion with the following questions:

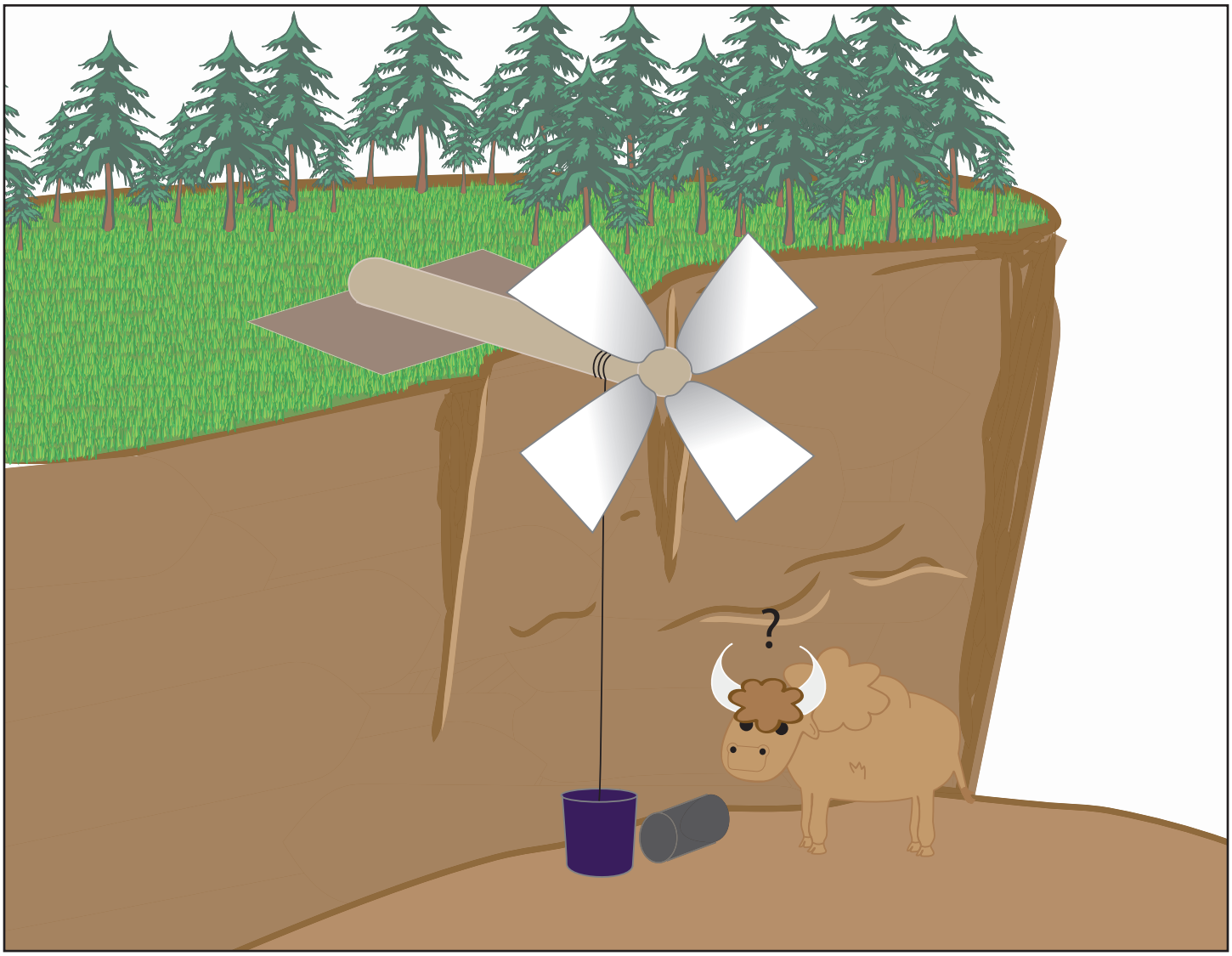
    - ❍ If you had time to redesign your wind-powered crank what changes would you make? *(If there is time remaining, we encourage girls to try again for improved results. This is in keeping with the **Engineering Design Process**.)*
    - ❍ Where do you think it would be effective to use wind for power? *(Near coastlines and flat land, not near bat and bird flight paths.)*
    - ❍ Why is wind energy desirable? *(Wind energy is free and clean.)*
    - ❍ What was challenging about this activity?
    - ❍ What kinds of other projects might a **Civil Engineer** like Melanie work on? *(Sewers, pipelines, and roadways.)*

Extension Resources:

1. Check out free lessons and activities from KidWind at http://learn.kidwind.org. "Blowin' in the Wind" is a great episode of PBS' SciGirls where girls visit the KidWind warehouse and build a wind-powered bird bath: http://pbskids.org/scigirls/video2?asset=show106

2. Silly jokes, fun experiments and resources about wind and other renewable resources are available from the U.S. Energy Information Administration at www.eia.gov/kids.

Wind-Powered Crank



Note:

Salary information is from the National Bureau of Labor Statistics Occupational Employment and Wage Estimates as of May 2009.

Civil Engineer

Civil Engineers design infrastructure, meaning utilities including water lines, sewers, and storm water lines. They are responsible for designing roadway developments, including sidewalks, stoplights and stop signs, roads, and highways to help traffic flow in a fast, effective way.

As a **Civil Engineer** you could provide sidewalks and bicycle lanes along a street, develop techniques to re-use storm water, or develop a system to provide safe drinking water to a small village in Africa. The annual salary is $81,180, which is about $39 per hour.

Melanie Lapointe
Degree in Civil Engineering

Melanie's Biography:

I always knew I wanted to study science, and I especially liked biology and math. After my first year in college, I realized I did not enjoy the long hours in the labs. I decided to transfer into engineering with a focus on the environment, which would allow me to continue my pursuit of biology. Now, I work for the oldest general contractor in California and built the first LEED (Leadership in Energy and Environmental Design) certified hotel in the state!

Typical Day on the Job:

My job as a **Civil Engineer** is to write reports and create construction drawings to build catch basins, sewers, and water lines. Once a week I visit a construction site to make sure that the contractors are placing the catch basins in correct locations per my construction drawings so that all rain water drains from the site. I often communicate with the city engineers and reviewers to make sure that my construction drawings are following the city code.

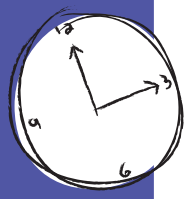
Here's what I know: (Wind-Powered Crank)

As a **Civil Engineer,** I put wind turbines in windy areas such as the mountains. To build the enormous turbines, I also need to build roads large enough to carry trucks and cranes to the site. I know it's important to keep the turbine blade balanced and lightweight. Another important tip is the blade has to rotate, so be sure the axle on your wind-powered crank can move freely.

Clean This Water

1 Hour

+ 15 minutes preparation time



Materials:

Per individual

- Clean This Water handout
- pencils
- gravel
- sand
- coffee filters
- cotton balls or gauze
- activated carbon (charcoal)
- scraps of cotton and denim cloth
- utility knives
- scissors
- Environmental Engineer career cards
- 1 plastic bottle (not included)

Per Class (dirty water)

- 2 gallon bucket filled with water
- soy sauce (to represent chemicals)
- dried beans (to represent animal/human waste)
- organic potting soil (to represent soil)
- vegetable oil (to represent motor oil)
- torn pieces of paper & styrofoam (to represent litter)

Grouping: Individual

Introduction: In this activity, girls will build a water filter using materials found at their campsite and in their backpacks.

Objectives: As a result of this activity, the girls will be able to:

- Recognize that common materials can be used to create solutions for difficult problems
- Describe the difference between a physical filter (sand, coffee filters, cotton) and a chemical filter (activated carbon)

Science Behind It:

Most of the materials in the filter are acting as physical barriers to trap the contaminants. Sand is a natural filter that can remove many impurities from the water, like dirt and oils. Having gravel below the sand keeps the sand in place and prevents it from clogging the openings at the bottom.

The activated charcoal, or carbon, is a chemical filter and removes smaller particles from the water. Activated carbon is a type of carbon that is very porous, and has an extremely large surface area, like a honeycomb. Because of this large surface area, the water flows over more carbon, providing many opportunities to be filtered. As the water flows through, smaller particles like lead and other chemicals are attracted to the pores in the carbon, and the particles are filtered out. Home water filtration systems, like Brita® water filters, use activated carbon particles as well.

Activated carbon also has industrial uses. Carbon can be manufactured to have different pore sizes, to respond to the needs of the application. For example, it has been used to clean chemical spills from water sources.

Clean This Water

Preparation:

- **Cut** at least one plastic bottle to make a filter as shown in the illustration on the *Clean This Water* handout, so that the girls have an example of a correctly cut bottle.
- **Caution.** Older girls can use the utility knives to cut their own bottles, but the leader may choose to cut the bottles for younger girls. For safety, be sure to *cut away from your body*.
- **Set out** the filter materials.

Opening (5 minutes):

1. **Read** the scenario to the girls:

   Your group needs clean water to drink and cook with, but the water pump at the campsite has broken due to the earthquake. There is a river, but the water may contain pollutants. Cari, from SWE, mentioned that it may be possible to build your own water filter.

2. **Explain** to the group that each girl must design and build a water filter that can filter out all the pollutants that may be in the river water.

3. **Lead** a discussion with the girls by asking them to imagine living in an area of the world that does not have access to clean water.

   - How would your life be different without local access to clean water? *(Some kids must walk long distances daily to fill their family's water basins at a well or stream, taking time away from school. Readily available clean water also reduces illness since we can wash ourselves and our food more easily.)*

4. **Make** the dirty river water in front of the girls so they see what they will need to filter out. As you add each item, read out loud what pollutant is represented by each item. See the materials list for items that are needed to make the dirty water.

5. **Show** the girls what materials they have at the campsite that might work for a water filter:

   - Water bottles that each of the girls had brought from home
   - Coffee filters that the leaders brought to make coffee in the morning
   - Cotton balls or gauze from the first aid kit
   - Scraps of denim and cotton cloth from clothing
   - Gravel and sand from the river bed
   - Charcoal ash from last night's campfire

6. **Brainstorm.** Each girl will make her own filter, but girls should be encouraged to work in groups of two or three to brainstorm together. Allow the girls to look at the different materials they can use and the bottle you cut before the session so they can see how the materials can be layered in the top portion of the bottle.

Note:
Activated carbon needs to be soaked before use to improve filtering.

7. **Point out** that charcoal can remove chemical substances from polluted water. Each girl needs only two spoonfuls of charcoal.

Brainstorm (10 minutes):

8. **Hand out** the **Environmental Engineer** role model career cards. Ask for a volunteer to read the entire card to the group, including "Here's What I Know" on the back.

9. **Discuss**, in groups, which materials they think will work best. Consider the following questions:

   - How will each material filter out the different parts of the dirty water?
   - Why is it necessary to use more than one material in the filter? *(Different size materials help to fill in all the nooks and crannies in the filter, making it more difficult for solids to pass through.)*

10. **Give** each girl a bottle diagram and a pencil to sketch her plan for the filter layers. Have the girls clearly label each layer. Once the girls have finished their design for their filter, have them check-in with you on their design.

Hands-On (25 minutes):

11. **Distribute** a plastic bottle and a utility knife to each girl to cut off the bottom half of the bottle or hand out the pre-cut bottles. The top half will be where the girls will build their filter and the bottom half will catch the filtered water. Girls can then gather and layer the materials for their filters.

12. **Allow** the group fifteen minutes to build their filters. Mingle and ask the girls:

    - What materials are you using and why?
    - What do you predict will happen?

13. **Test** the filters one at a time in front of the group and discuss the results.

14. **Note.** This water is drinkable, since there are no added chemicals to the organic potting soil. Encourage the girls to do a smell and taste test of their water as part of their evaluation.

Note:

If your girls enjoy competitions, have two or more girls go up against each other to compare the results of their filters. We also suggest having the whole group start filtering at the same time, and at a designated time interval (say three seconds) have each girl mark the water level on her bottle with a sharpie, then compare results.

Reflection (10 minutes):

15. **Discuss** the results by asking the girls questions about the differences they notice in the filters,

probing for the understanding that activated carbon is needed to filter out the "chemicals."

16. **Lead** a discussion using the following questions:

- ❍ Which material seems more difficult to filter out?
- ❍ Which materials seemed to work best for certain pollutants?
- ❍ Why is it important that engineers and scientists are working in the area of water filtration?
- ❍ Why is it important that common materials can be used to filter water?

Redesign (10 Minutes):

17. **Redesign.** Allow time for girls to go back to their groups and redesign their filter, based on their findings. We recommend the following order: at the bottom of the filter, place a coffee filter, then charcoal, cotton, gravel, and sand. Compare the clarity and taste of the water of the redesigned filter to the first.

18. **Discuss** the following questions:

- ❍ How did you improve your water filter after testing?
- ❍ What were some lessons learned?
- ❍ Do some materials filter better than others?

Extension Resources:

1. Discuss worldwide efforts to increase access to clean water:

The United Nations Millennium Development Goals are eight linked objectives set out by the UN in 2000 to combat worldwide poverty. One of the goals involves improving access to clean water. Discuss worldwide water issues and efforts to combat clean water shortages with your group.

Visit http://www.wagggsworld.org/en/take_action/gat/mdgs/mdg7 for ideas (from the World Association of Girl Guides and Girl Scouts) or www.tapproject.org (from UNICEF).

2. Hold an event on World Water Day:

World Water Day occurs on March 22, with a different theme every year. Events are held around the world promoting the cause of increasing access to clean water. Find out more at:

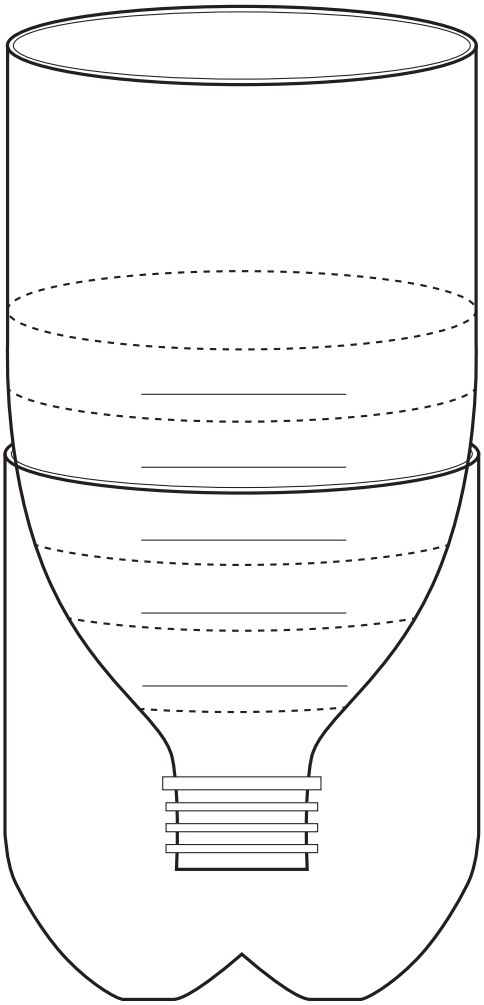
http://www.worldwaterday.org.

3. Check out the innovative science behind harvesting water from fog at http://teachers.egfi-k12.org/lesson-water-from-fog.

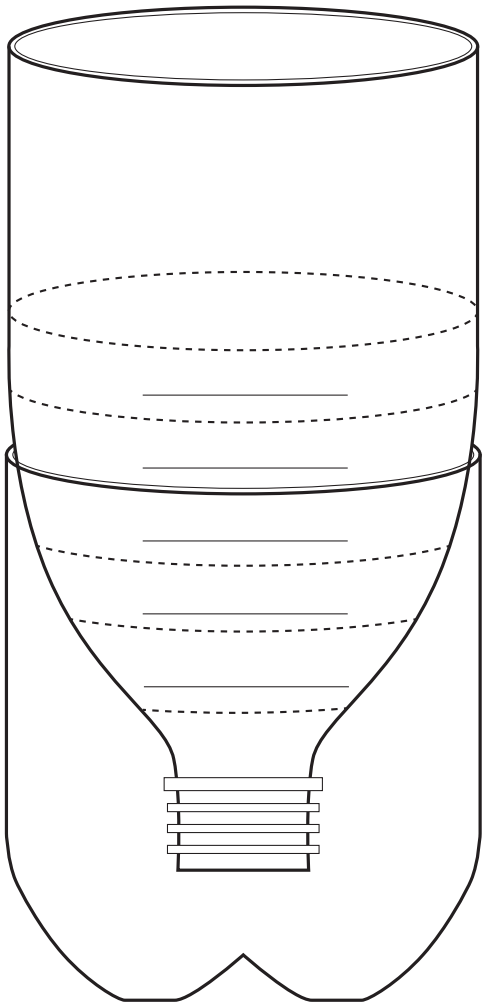
Clean This Water Handout

Below are two empty water filters. Draw and label each layer of filtering materials that you're experimenting with.

Trial 1



Trial 2



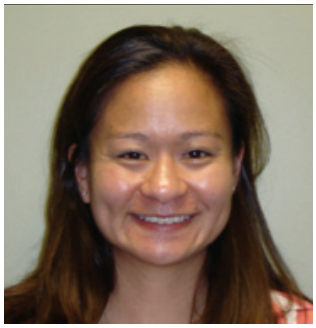
Techbridge

Engineers to the Rescue

Environmental Engineer

Environmental Engineers work to make sure pollutants are not released into the air or water and come up with ways to create a cleaner environment. They help make a real difference in the survival of our planet by finding ways to clean up our oceans, rivers and the air we breathe.

Environmental Engineers are working on designing products that create little waste, inventing better ways of recycling, and removing poisons from well water in developing countries. The annual salary is $80,750, which is about $39 per hour.



Cari Ishida
Degree in Environmental Engineering

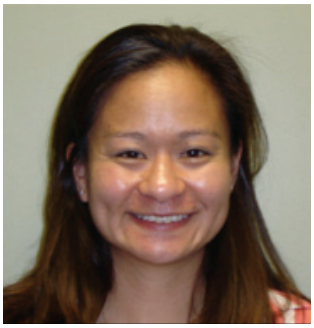
Cari's Biography:

I studied engineering because my high school counselor told me I should try it since I did well in math and science. I became an engineer because I enjoy solving puzzles and problems. In graduate school I studied how wetlands can remove pollutants and provide habitat for animals. I work for Carollo Engineers, which specializes in the planning, design, and construction of water and wastewater facilities.

Typical Day on the Job:

I write reports for construction sites to describe ways to minimize pollution during construction. My reports are written prior to construction starting and reviewed by the city. Once construction begins, I do several site visits each week to make sure that the contractors are not polluting the streams with construction waste, and that they are following my report's plans. I turn in my weekly site visit report to the city to show that the contractor is following my plans and specifications.

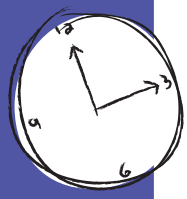
Here's what I know: (Clean this Water)



As an **Environmental Engineer**, I've noticed there are lots of pollutants in water today. For your water filter, first think about how to remove all the larger particles like man-made trash and animal waste. Then, focus on which materials will block medium-size pollutants like soil. The most difficult things to filter out are chemicals, like pesticides and oil. Unlike trash and waste, we don't have any materials that can physically block liquids and chemicals. We have to block chemicals with other chemicals. For example, I know processed carbon can filter out tiny particles like lead.

Tune in Techbridge

30 Minutes



Materials:

Per Group

- 1 set of 5 career cards
- 1 pen
- 24″ of aluminum foil
- 15 toothpicks
- 10 craft/popsicle sticks
- 12″ of masking tape
- 1 golf ball
- measuring tape

Grouping: 2 - 4 Girls per group

Introduction: In this activity, girls will work in teams to construct a structure from foil and toothpicks that will represent an antenna.

Objectives: As a result of this activity, the girls will be able to:

- Experience the creative power of brainstorming
- Work effectively with a team on a single task
- Work within a tight deadline

Opening:

1. Read the scenario to the girls:

   Since the big quake hit, our phones have lost all signal and we can't contact anyone! We don't even have a radio signal. Melanie, from SWE, suggested making a really high antenna to replace our old radio antenna. Good luck!

Brainstorm (14 minutes):

2. **Arrange** the girls into groups of two to four and hand them a set of career cards. Tell them that you're going to quiz them on facts from the cards, and for each correct answer, they can get an additional inch of tape to build their antenna. Every group starts with the same amount of materials, but teams who are particularly "in tune" with the careers profiled on the cards will gain extra tape!

3. **Review.** Give the groups five minutes to review the career cards, then collect them.

4. **Begin** the career card quiz. You can alternate between asking the teams questions, and if the first team does not answer the question correctly, you may allow the next team to answer instead. Refer to the sample questions on the following page.

5. **Hand out** the extra tape as the teams answer correctly. If a team suggests a different answer and is able to explain why that engineer might work on that task, feel free to validate their good thinking by awarding tape.

Hands-On (10 minutes):

6. **Build.** Allow each team ten minutes to build the tallest antenna. Remember that the antenna needs to be strong enough to hold the weight of the receiver (golf ball) and tall enough to receive a signal.

7. **Measure** each group's antenna to determine which is the tallest structure that is able to support the golf ball.

Reflection (6 minutes):

8. **Discuss** the different strategies the groups came up with. Invite the girls to examine each other's antennas and compare the strategies that enabled one structure to be taller than another.

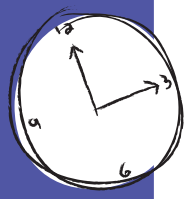
   - ❍ Did you abandon any ideas as you were building? Why or why not?
   - ❍ Which structure looks most effective?
   - ❍ Did any of the towers collapse? Where did the failure occur? What happened and why? How could it could be avoided in the future?

Career Card Questions:

- Which engineer would be most likely to build roads? *(Civil)*
- Which engineer would be most likely to design a toy? *(Mechanical)*
- Which engineer is concerned with the quality of air? *(Environmental)*
- Which engineer is most likely to design a bridge? *(Structural)*
- Which engineer is most likely to work on placement of a parking lot? *(Civil)*
- Which engineer is most likely to design the parts of a new bicycle? *(Mechanical)*
- Which engineer might take soil samples back to her lab? *(Geologist)*
- Which engineer would be most likely to visit a sewer? *(Civil)*
- Which engineer might design parts of an airplane? *(Mechanical)*
- Which engineer might find crystals and geodes while on the job? *(Geologist)*
- Which engineer might test and report contaminated water? *(Environmental)*
- Which engineer is most likely to step on scaffolding while a building is constructed? *(Structural)*

Fractured Facts

15 Minutes



Materials:

- 1 set of 24 Q&A cards

Grouping: Entire Group

Introduction: In this activity, girls will mingle and try to find the person who has the other half of the question/ answer pair.

Objectives: As a result of this activity, the girls will be able to:

- Learn facts about the world related to engineering solutions
- Find a partner for the next activity

Directions:

1. **Hand out** either a question or answer card to each girl. Some girls will get more than one card.
2. **Ask** the girls to mingle and read their cards to each other until girls with matching question and answer cards meet.
3. **Unite** the pairs and have the girls read the questions and answers.
4. **Ask** the girls to share with the whole group one fact that they were surprised by. If no one volunteers a response, you might ask them some of the *Fractured Facts* questions such as how many gallons of water the average person uses every day, or what states they think have the most potential to harness wind energy and why?

Fractured Facts Q&A Cards

Q How many people in the world do not have access to clean water?

A 884 million people

Q How many gallons of water does an average person in the USA use every day?

A 106 gallons

Q How many detectable earthquakes are there estimated to be each year?

A 500,000, but only about 100,000 of those are large enough to be felt

Q What was the largest recorded earthquake in the world?

A Magnitude 9.5 in Chile on May 22, 1960

Q What are the top five states that get more than 5% of their electricity from wind?

A Iowa, Minnesota, North Dakota, Oregon, and Colorado

Q Around 7 A.D., the first windmills were developed. What were they used for?

A They were used to grind grain and pump water for irrigation.

Fractured Facts Q&A Cards

Q What is the annual total of SWE scholarships for women in college and graduate school?

A More than $500,000

Q What has been the goal of the Society of Women Engineers since its founding in 1950?

A Help women engineers leave their footprints in the field and encourage them to "Aspire. Advance. Achieve." throughout their careers.

Q How many members does the Society of Women Engineers have?

A 20,000 members. More than half are students.

Q How many grizzly bears reside in Yellowstone National Park?

A 500 bears

Q How many earthquakes shake the ground at Yellowstone National Park each year?

A 1,000 to 3,000 earthquakes

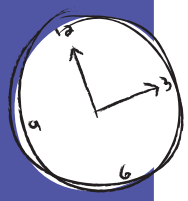
Q What is the largest member of the deer family that you can find at Yellowstone National Park?

A moose

Give Me Shelter

1 Hour

+ 10 minutes preparation time



Materials:

- rectangular pie pan
- round pie pans
- golf balls
- soil
- water
- ash
- sand
- pea gravel
- clay
- plastic leaves
- bamboo skewers
- twine
- construction paper cut into 4″ squares
- pencils
- rulers
- Soil Types handout
- job description posters
- Geologist career cards
- Structural Engineer career cards
- masking tape
- scissors
- measuring cups
- scrap paper
- stopwatch
- spray bottle
- blow dryer and extension cord
- paper towels (not included)

Grouping: Pairs

Introduction: In this activity, girls will take on different engineering roles and build a structure that can withstand an "earthquake" and a "rainstorm."

Objectives: As a result of this activity, the girls will be able to:

- Describe how **Geologists** and **Structural Engineers** work to build stable structures
- Describe the characteristics of a soil type of their own creation
- Describe the characteristics of a stable structure

Science Behind It:

The stability of a structure can be affected by shape (such as a wider base, or a narrow peak), materials, integrity of construction connections, and additional supports (like flying buttresses on great cathedrals).
The existing natural conditions of a structure's site can affect its stability, too. You may want to share with girls that a specialized field of engineers, **Geotechnical Engineers**, examine soil for the kinds of rock and minerals present, and for the water and air in the spaces in between soil particles.

Preparation:

- **Display** the *Geologist Job Description* poster in one designated area, and lay out the sand, ash, soil, pea gravel, clay, round pie pans, rulers, and measuring cups. Make sure there is access to water.
- **Post** the *Structural Engineer Job Description* poster in another area and lay out the popsicle sticks, bamboo skewers, twine, plastic leaves, masking tape, rulers, and scrap paper.
- **Set up** the Testing Zone in a third area. Place all of the golf balls in a rectangular pie pan to make the shake table, pour water into the spray bottle (to simulate rain), plug in the blow dryer (to simulate wind), and cut the construction paper into quarter pieces (the object to keep dry under the shelters). Lay out the stopwatch and paper towels (for clean up).

Give Me Shelter

Opening (10 minutes):

1. **Read** the scenario to the girls:

   Your tents were wrecked by the falling debris during the earthquake, so you need to build new shelters. You have tree branches, large leaves, tarps, and rope to build your shelters, and they need to protect you from wind, rain, and any aftershocks of the earthquake. Here's the advice from Kittrina, the Structural Engineer in the SWE team (Read, or ask a volunteer to read the back of the Structural Engineer career card). *There are different areas of camp you can build in, and each has a different soil type. Jeanette, the SWE Geologist, has this to say about soil found at Yellowstone* (Read back of Geologist career card).

2. **Explain** to the girls they will work in pairs to build a structure that can withstand rain, wind, and any aftershocks on a certain type of soil.

3. **Pass out** the *Soil Types* handout and pencils.

4. **Introduce** the two different jobs one member of each pair will role play.

   - The **Geologist** will research the different soil types around camp. Based on her findings, she should make a recommendation about which kind of soil she would prefer to build on. The **Geologist** should write a formula for her soil, carefully noting the quantities of each ingredient, as she assembles it in her round pie pan.
   - The **Structural Engineer** will design a shelter based on her knowledge of structural safety and the soil type her **Geologist** has decided to build on.

5. **Establish** the following specifications for their shelters:

   - It must be at least as large as a quarter size sheet of construction paper.
   - It must be at least 4 inches tall at its highest point.
   - It must withstand the following tests:
     * 20 seconds of shaking on the "shake table" to simulate aftershocks of the earthquake.
     * 20 seconds of blowing from the blow dryer to simulate a windstorm.
     * 20 seconds of spraying with the bottle to simulate a rainstorm.

Brainstorm (10 minutes):

6. **Allow** the pairs ten minutes to design and sketch their shelters, read about their soil types, and begin to think about what they'd like to make. Ask them the following questions to help with brainstorming:

   ❍ Has anyone experienced an earthquake, or severe wind or rain storm before? What did you notice about the place you sought shelter in?

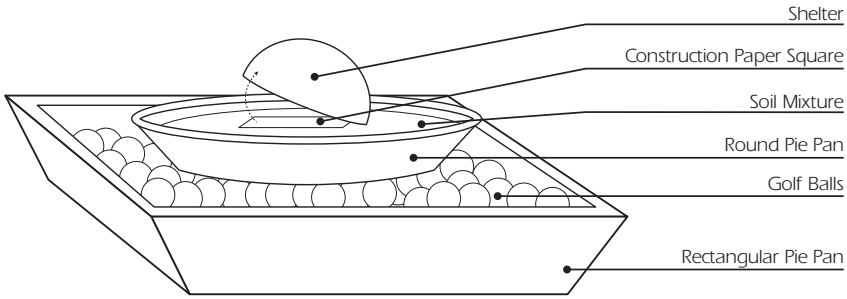
   ❍ What kinds of materials do we have available at our campsite, and what are the pros and cons of each material?

- How would you describe the soil we have here (in the place we live or where this group is meeting) to someone who cannot see or feel it?
- Have you ever camped on ground that was uncomfortable? What made it so?
- What types of shelters have you seen or heard about that survive earthquakes, stand up to high winds, or shed rainwater?
- What kinds of soils do you think will be most stable? Why?

Hands-On (30 minutes):

7. **Set up** two areas, one for **Structural Engineers**, the other for **Geologists**, and separate their working materials.

8. **Explain** that each **Structural Engineer** and **Geologist** will go to her respective station for twenty minutes. The **Geologist** will develop the soil using her soil formula, while the **Structural Engineer** will build her shelter. The girls should place a construction paper piece under the shelter, on top of their soil, for testing.



9. **Test** each shelter using the three stress tests (see poster) in the following order: earthquake, wind, then rain. If the construction paper underneath the structure is wet, then the natural elements got through their shelter's design. Ask the girls to evaluate their shelter based on how sturdy it appears after the "earthquake" and "windstorm," and how wet the construction paper is after the "rainstorm."

Note:
For an additional challenge, if your girls are experienced with knots, ask them to lash together their structure with string rather than use tape. Now they're really roughing it!

Reflection (10 minutes):

10. **Consider** the design decisions and ask the girls:

- What types of features affect building stability? *(The kind of foundation, the types of support beams and reinforcement of joints, wide to narrow dimensions (wide at base, narrow at top), low center of mass, the strength and properties of the building materials.)*

- How did the soil type affect the sturdiness of your shelter? Did you make adjustments to your design to respond to the way your soil looked or felt?
- Seeing how your shelter, and other people's shelters performed in the stress tests, what would you do differently now?
- What other materials would have been helpful in your design?
- Where in the world would you use the knowledge you just gained from these experiments? How could the work of a **Geologist** or a **Structural Engineer** help someone else? *(These professionals give advice about how to build differently to address the natural conditions of the site, and choose where to dig or drill.)*

Extension Resources:

1. Check out PBS's NOVA website for online stability simulations of bridges: www.pbs.org/wgbh/nova/bridge/.
2. ISSMGE.org is the International Society for Soil Mechanics and **Geotechnical Engineering,** which is a growing specialty within **Civil Engineering**.
3. Make your own topographic map using clay, floss, rulers, toothpicks, pencils, and paper. See http://spaceplace.nasa.gov/topomap-clay/en/ to learn how.

Soil Types Sheet

Yellowstone National Park is located at a site with a lot of geothermal activity. That means that earthquakes, geysers, and volcanoes are common. These features affect the soil found throughout the park. Jeanette, our SWE **Geologist**, notices the following at our Buffalo Ridge campground:

- Rivers transport lots of small rocks and sediment, which means that these materials can be moved around and deposited in different places. This also happens in areas where rivers or bodies of water used to be millions of years ago. Based on the sediment at our campsite, it is likely a former riverbed.
- When volcanoes erupt, they spew lots of burning hot material into the atmosphere. This material cools as it falls back to earth and ends up on the ground as volcanic ash or dust. The presence of this material indicates a volcano nearby.

Consider the following types of soil found at our Yellowstone campsite and then make a decision about where you want to build shelter. Follow the formula's proportions to make enough soil to fill your round pie pan at least one inch deep. Take careful notes about the total amounts of each material you use.

Soil Type	Description	Soil Formula
Alluvium	Alluvium is sediment that has been transported by water. Alluvium is made up of a variety of materials, like gravel, sand, and clay.	Mix together 1 cup soil, ¼ cup water, and ¼ cup of pea gravel. Place the mixture on top of a thin layer of clay.
Sand	Sand is made of rock particles smaller than 2 mm. It can absorb lots of water and is made up of lots of different types of rock.	Mix 1 cup of sand and ¼ cup of water. Place on top of at least ¼ cup of pea gravel.
Volcanic Dust and Ash	Volcanic dust and ash result from falling debris after a volcanic eruption. Some volcanic rock, like basalt, is dense, while another like pumice, is able to float.	Mix ½ cup of soil, ½ cup of ash, and ¼ cup of water.

Our Soil Formula:

Note the measurement of each material you use.

Pea Gravel _____ Clay _____ Ash _____

Water _____ Soil _____ Sand _____

Our Topography:

(top view)

Techbridge

Engineers to the Rescue

Shelter Sketch Sheet

Kittrina, our SWE **Structural Engineer**, helps us gather materials around our campsite to use to rebuild our shelter. As we pick up various building items, she shares the following information:

- Triangles are a strong shape because they are wide at the bottom and narrow at the top.
- Arches and domes have similar strength because they are narrower at the top than at their base. Slanted walls have to be anchored to something, though, to avoid blowing over.
- Houses tend to be boxy in shape because wood does not bend as easily as reeds or grasses. Rectangles and squares need reinforcement at the points where they meet (the joints) to stay at right angles. But they offer plenty of head room for standing comfortably!

Here are some design inspirations for your shelter:

Quonset Hut

Teepee

Yurt

Tunnel Tent

Design your shelter here and label the materials you'll use:

I think our shelter will be best for surviving the stress tests of earthquakes, wind and rainstorms because...

Techbridge

Engineers to the Rescue

Geologist

The **Geologist** in the group will research the types of soil around the campsite. You will:

- Make a recommendation about the type of soil to build on
- Make your soil out of the provided materials
- Keep detailed notes about the quantities of materials you use

As a **Geologist**, I've learned the soil in Yellowstone is mostly sand. However, Yellowstone is also home to lots of volcanoes. Every time they erupt, ash is thrown up into the air, then settles down to the ground making a layer of very fine-grained soil called silt. This mixture of silt and sand is good to build on, but there are some negatives. When silt and sand are dry, they hold up very well, but if they are wet, they can liquefy when shaken by an earthquake. Picture what happens when you shake up a frozen drink and it becomes more watery. You have to support your shelter so that it can withstand liquefaction if an earthquake occurs after it rains.

Structural Engineer

The **Structural Engineer** will:

- Design and build a shelter based on the soil type
- You can only use the materials provided and must take into account your findings as the geologist
- Your shelter must be at least 4 inches high and large enough to accommodate a quarter-sheet of paper

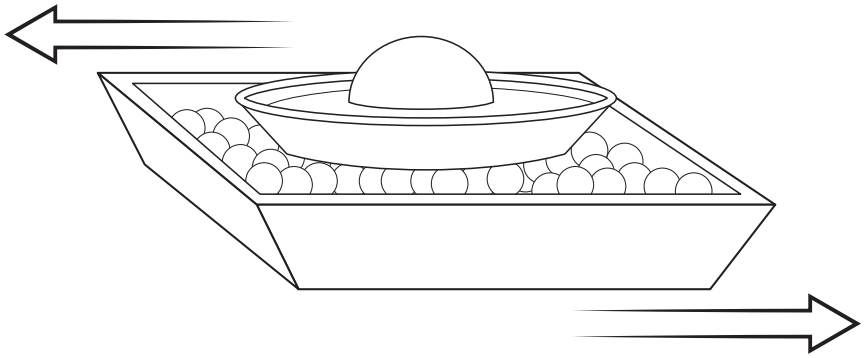
As a **Structural Engineer**, the first thing I have to think about when I design and build a structure is the foundation. I think about the shape of the base and how far underground it needs to be. I also use triangles in my designs, since they are the strongest shape. Often, a building is smaller at the top than at the bottom so it doesn't tip over. Some examples are electrical towers and teepees.

Stress Tests

Your shelter must be submitted to these tests in the following order:

- **Earthquake:** shake for 20 seconds
- **Wind:** blow in one direction for 20 seconds on high speed
- **Rain:** spray in all directions for 20 seconds

1.



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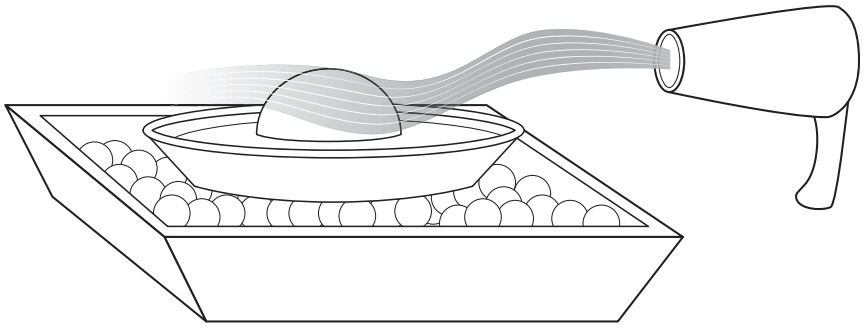

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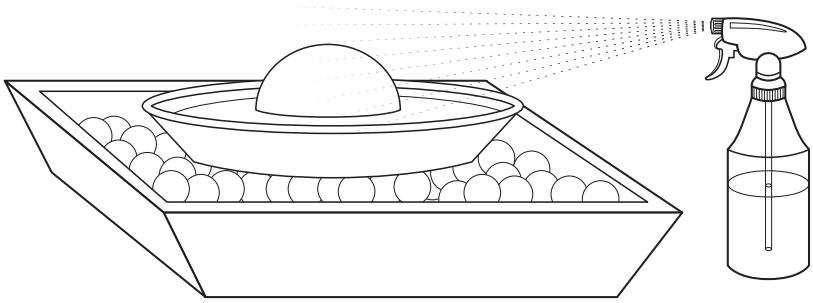


Structural Engineer

Structural Engineers design and build structures from skyscrapers to bridges. They think about how to make these structures using steel, wood, cement, or a combination of materials. They ensure a building will stand up straight and also make it safe in all types of weather including earthquakes, snow, or heavy winds.

As a **Structural Engineer** you could build a school that would survive an earthquake, design the tallest green building in the world, or design a Golden Gate Bridge of the future! The annual salary is $81,180, which is about $39 per hour.

Kittrina McCourt
Degree in Structural Engineering

Kittrina's Biography:

When I was in middle school I wanted to be a gourmet chef. I loved to cook, (and still do) but wanted a career that was more mathematics oriented. When I was in college I had no idea what I wanted to study, but my career counselor recommended engineering to me because I took a lot of math and I enjoy solving problems. I chose my focus in **Structural Engineering** because I liked bridge and building design.

Typical Day on the Job:

My typical day involves writing reports and producing structural drawings. As a **Structural Engineer** I make sure that buildings are safe and structurally sound. The drawings that I create are sent to the city to approve and then used at the construction site to build the buildings.

Here's what I know: (Give Me Shelter)

As a **Structural Engineer,** the first thing I have to think about when I design and build a structure is the foundation. I think about the shape of the base and how far underground it needs to be. I also use triangles in my designs, since they are the strongest shape. Often, a building is smaller at the top than at the bottom so it doesn't tip over. Some examples are electrical towers and teepees.

Geologist

Geologists are scientists who study the rocks and minerals that make up the earth. **Geologists** work to figure out what happened to make Earth the way it is, and what will happen to the planet if these processes continue. **Geologists** study volcanoes, predict earthquakes, or study the natural gases below the surface of the Earth.

As a **Geologist**, you may test sample cores taken from the bottom of a tropical ocean or from beneath the polar ice caps, or even study rocks from the moon! The annual salary is $92,710, which is about $44 per hour.

Jeanette Hummel
Degree in Geology

Jeanette's Biography:

After graduating high school, I took a few general education classes while working full time. At twenty-five with two small children, I began college full time. I graduated college at twenty-nine and have never been happier. When I was in middle school I wanted to be a famous singer or a veterinarian. I chose to be a **Geologist** because I love being outside and hated the idea of working in an office everyday for the rest of my life. My time now is split between office work and field work.

Typical Day on the Job:

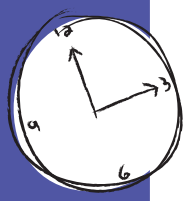
My job is to design and oversee construction of water wells for public supply. I study the geology of an area, analyze drill cuttings from test holes and data from nearby wells and then use all that information to design a well for that location. After the design is complete, I oversee all the construction and testing of that well.

Here's what I know: (Give Me Shelter)

As a **Geologist**, I've learned the soil in Yellowstone is mostly sand. However, Yellowstone is also home to lots of volcanoes. Every time they erupt, ash is thrown up into the air, then settles down to the ground making a layer of very fine-grained soil called silt. This mixture of silt and sand is good to build on, but there are some negatives. When silt and sand are dry, they hold up very well, but if they are wet, they can liquefy when shaken by an earthquake. Picture what happens when you shake up a frozen drink and it becomes more watery. You have to support your shelter so that it can withstand liquefaction if an earthquake occurs after it rains.

Your Career Card

20 Minutes



Materials:

Per Girl

- 1 blank career card
- 1 pencil

Per Group of 10

- 2 sets of 5 role model career cards
- 2 boxes of permanent markers

Grouping: Individual

Introduction: In this activity, girls will think about their futures and create a role model career card about themselves.

Objectives: As a result of this activity, the girls will be able to:

- Illustrate future career plans
- Consider career options

Preparation:

- **Optional.** Take and print headshot photos of your girls ahead of time and attach them to the cards.

Directions:

1. **Pass** around the role model career cards from this box and give the girls a chance to become familiar with them. Discuss some of the projects they have done so far and some of the careers they have learned about during those activities.
   - Which of these careers most appeal to you?
   - What does an **Environmental Engineer** do?
   - What does a **Structural Engineer** do?
2. **Explain** that they will be making their own career cards today. Girls will need to choose a career from the career cards.
3. **Ask** them to think about what college they might attend for this career and what degree they might have. Would they like to have a family? Where do they see themselves living?
4. **Give** the girls ten minutes to make cards for themselves modeled after the role model cards in your box. If any girl is having trouble choosing a career, ask her to think back on what activity she liked the best or what career she thought was most interesting.
5. **Present** these career cards to the group. Discuss why girls chose a specific career.
   - Why did you choose this career for yourself?
   - What other things do you hope to accomplish in your future?
   - Explain why science and engineering are good careers for women.

Your Career Card

Your Career Card

Techbridge

Picture

Name

Occupation

Degree in:

Biography:

Interesting Facts:

At my job, I work on...

Your Career Card

Techbridge

Picture

Name

Occupation

Degree in:

Biography:

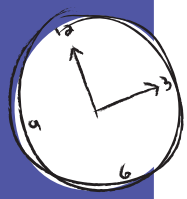
Interesting Facts:

At my job, I work on...

Car to the Rescue

70 Minutes

+ 15 minutes preparation time



Materials:

Per Group

- toy wooden wheels
- skewers
- drinking straws
- cardboard
- glue guns and glue sticks
- duct tape
- scotch tape
- hole punchers
- scissors
- measuring tape
- spools
- foam board pieces
- popsicle sticks
- rubber bands of different strengths and sizes
- Mechanical Engineer career cards
- Engineering Design Process poster

Grouping: Pairs

Introduction: In this activity, girls will design and construct a rubber band-powered car and test how far it can travel under its own power.

Objectives: As a result of this activity, the girls will be able to:

- Describe how stored elastic energy can be transformed into kinetic (motion) energy
- Describe how a wheel and axle functions as a simple machine
- Describe what a **Mechanical Engineer** does

Science Behind It:

The girls are using a simple machine—the wheel and axle—to reduce the amount of force needed to move the object forward. The wheel and axle must be able to rotate freely, and cannot be attached directly to the car. This is why a cylinder to contain the axle is needed. Friction will play a larger role in this simple machine due to this constraint.

When stretched, the rubber band contains stored energy known as potential energy. By wrapping one end around the axle to stretch it, you are getting ready to exert force when you let it go.

When released, the potential energy becomes kinetic energy for the rubber band, which will become the kinetic energy of the axle. The energy released depends on several factors, like how far the rubber band is stretched and how strong it is. The car will want to have as much stored energy as possible, so it can go the farthest distance without another energy source.

Preparation:

- **Remind** yourself which combinations of wheels, axles, and cylinders work best together. Play with the available materials.
- **Understand** how to wrap a rubber band around the axle to power the car so you can help the girls. See the end of this activity for details.
- **Prepare** the testing ground by laying the measuring tape on the floor to measure how far each car travels.

Car to the Rescue

Opening (10 minutes):

1. **Introduce** the scenario to the girls:

   Although we now have water, we need to find a way to get an urgent message to the park ranger's station. What about building a car with a note explaining our location attached to it? Judy, our ***Mechanical Engineer*** *from SWE, has some tips.* (Pass out the career cards and ask a volunteer to read Judy's advice.)

2. **Tell** the girls they will become **Mechanical Engineers** to design and construct a car that only runs on the power of rubber bands. We need to know how far it can travel without a downward slope or an extra cable pulling it along.

3. **Lead** a discussion about wheels and axles with the girls.

   - ❍ What do you know about wheels and axles?
   - ❍ How does a wheel and axle turn together? Do they need to be attached?
   - ❍ How do you attach the axle to the car while still allowing it to rotate? *(An axle can rotate freely within a cylinder. The cylinder can be the piece that's attached to the car.)*

Brainstorm (20 minutes):

4. **Explain** the parameters of the car:

   - The car can be powered by no more than three rubber bands.
   - The car may not have any human energy inputs (e.g., pushing).
   - Only the materials provided can be used in the construction of the car.
   - The car must have at least three wheels. A wheel is defined as anything that is round and can roll.

5. **Give** each girl a rubber band. Have her stretch it gently between her fingers and let one end go. Explain that when a rubber band is stretched, it can store **elastic energy**.

   - ❍ How does a stretched rubber band provide energy? *(It has the potential to bounce back, or move, when the stored energy is released.)*

6. **Explain** that when you stretch and hold the rubber band, it has **potential energy**, which is another word for stored energy. When you release the rubber band and it moves, it has **kinetic energy**, or energy of motion.

7. **Inform** the girls they have to figure out a way to store energy in the rubber band so it can power the car when the energy is released.

8. **Brainstorm**, in small groups of four or five girls, how to create a rubber band powered car. Distribute a few materials for wheels and axles, cylinders, and rubber bands. Give them five to ten minutes to come up with ideas.

9. **Gather** together to share ideas. The girls should come up with the idea to wrap one end of the rubber band around the axle, so that when it is released the axle and wheels turn. Ask the following questions to promote discussion:

   - How can you create potential energy with a rubber band?
   - Where should the other end of the rubber band be placed?
   - How will you get through the cylinder to power the axle with the rubber band?

Hands-On (30 minutes):

10. **Invite** the girls to get into pairs. Remind them of the parameters of the car and allow them to build using the materials provided.

    - How will the rubber band be attached to the axle? How will it be attached to the body of the car?

11. **Remind** them of the ideas generated in the brainstorming session if they are stuck.

12. **Test** how far their car travels.

Reflection (10 minutes):

13. **Lead** a discussion using the following questions:

    - How did you store energy in the rubber band?
    - What type of energy is stored in the rubber band when it is stretched? *(Potential energy or elastic energy.)*
    - When the tension in the rubber band is released, what type of energy is transferred? *(Kinetic energy, or energy of motion.)*
    - What elements of the car would you redesign?
    - What parts of a real car would a **Mechanical Engineer** work on?

14. **Redesign** the cars after the discussion if time permits.

Notes on Assembly:

Attach the rubber band to the axle and to the body of the car, then wind up the axle so the rubber band has tension. The following ideas may help the girls understand the concept of stored energy:

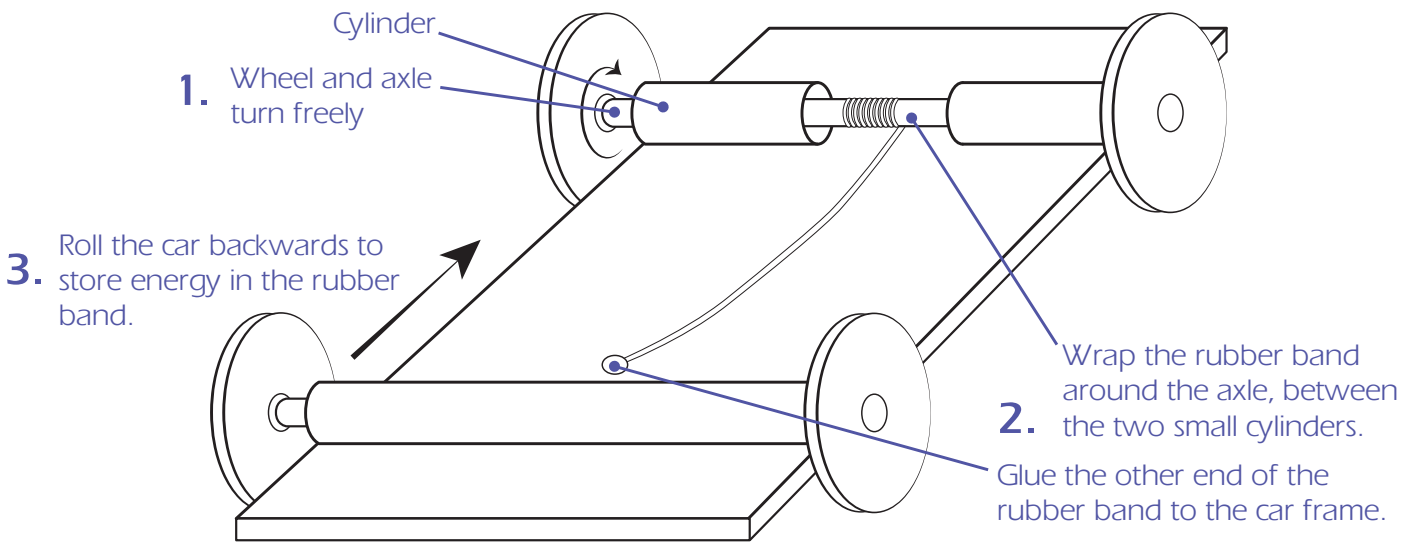
- Take apart a toy car powered by rubber bands so the girls can see how the backward

motion of the wheels creates tension in the rubber bands.

- If possible, build in time for research on the internet or in books.
- Build a model ahead of time to demonstrate how a rubber band can be wound around the axle to store energy and then release it.

Note:

1. Wheels need to be glued to the axle and the axle must turn freely inside a cylinder.
2. One part of the rubber band should be secured to the frame while the other end is wrapped around the **axle** (not the cylinder). Use two small cylinders to cover the axle, but leave room to wrap the rubber band.
3. The girls will have to roll the car backward, or turn the wheels back by hand, to store energy in the rubber band.



Extension Resources:

1. Check out **Mechanical Engineer**, Judy Lee, on PBS's "Design Squad" and NOVA's "The Secret Life of Scientists and Engineers" at video.pbs.org/video/1754147255/. You can also find Judy on EngineerYourLife.org.
2. There are also neat rubber band car instruction videos available on www.youtube.com. Check out musical21girl's "Rubber Band Car for School" and dmilad's "e28 project berkeley 06 trial 3." Notice that one design was tested on carpet while the other was tested on a smooth floor. Does the road surface make a difference?
3. See how rubber band cars influence the design of potential hybrid vehicles: www.hybridcars.com/types-systems/wind-hybrids-lessons-toy-cars-25372.html.

Mechanical Engineer

Mechanical Engineers design and test all kinds of mechanical things. Imagine your daily life and all the mechanical devices you use. They are designed by **Mechanical Engineers** who find out what we need and how best to make them so they're safe and work well.

As a **Mechanical Engineer**, there's no limit to the kinds of projects you might work on. You could design a bike that's easy to pedal up hills, a car that doesn't pollute, or you might create a mechanical game for blind children. The annual salary is $80,580, which is about $38 per hour.

Judy Lee
Degree in Mechanical Engineering

Judy's Biography:

As a kid, I loved taking things apart and trying to put them back together. I was always curious about what made things work. Having the chance to tinker helped me decide to study **Mechanical Engineering**. Today I have my dream job. As a **Mechanical Engineer**, I work in **Product Design** at IDEO, a creative design company. I have the chance to design a range of products—from toys to laptop sleeves. It never feels like work, it feels like fun!

Typical Day on the Job:

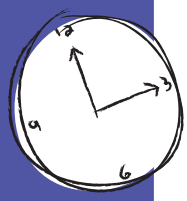
Mechanical Engineers like me work on all sorts of products and machinery. We specialize in building things that move in complicated ways. My friends from college (North Carolina State University) work in all different industries—some of them build bikes, some design large machines that are used in factories, and others work on medical tools.

Here's what I know: (Car to the Rescue)

As a **Mechanical Engineer**, I know that cars need both a wheel and an axle that turn freely. A wheel by itself can't be attached directly to the body of the car. I also know that when you stretch and hold a rubber band, it has potential energy, also known as stored energy. When you release the rubber band and it moves, it has kinetic energy, or energy of motion.

Girl of the Year

20 Minutes



Materials:

Per Individual

- Girl of the Year Praise Page handout
- markers
- pencils
- career cards

Grouping: Entire Group

Introduction: In this activity, girls will reflect on the engineering challenges they've encountered in this program, and highlight the successes of the group.

Objectives: As a result of this activity, the girls will be able to:

- Identify skills and abilities of the featured engineering careers in the program
- Develop healthy, supportive relationships
- Advocate for themselves and others

Directions:

1. **Explain** to the group that they are going to think back over the activities they've worked on in this program, and the challenges they've encountered while imagining a camping trip at Yellowstone. You may want to remind them of the scenarios, the tools they designed, and the skills they used to solve problems.

2. **Ask** the girls what they remember as being the most challenging or most fun activity they did in this program. Ask if they learned something they didn't know before.

3. **Review** the career cards from this project and ask the girls to remember which engineer helped with what activity. Ask them if there are some skills or qualities they imagine these women engineers might have that aren't listed on the career cards. Suggestions might include patience, creativity, courage, tolerance for others, or not giving up when something is hard.

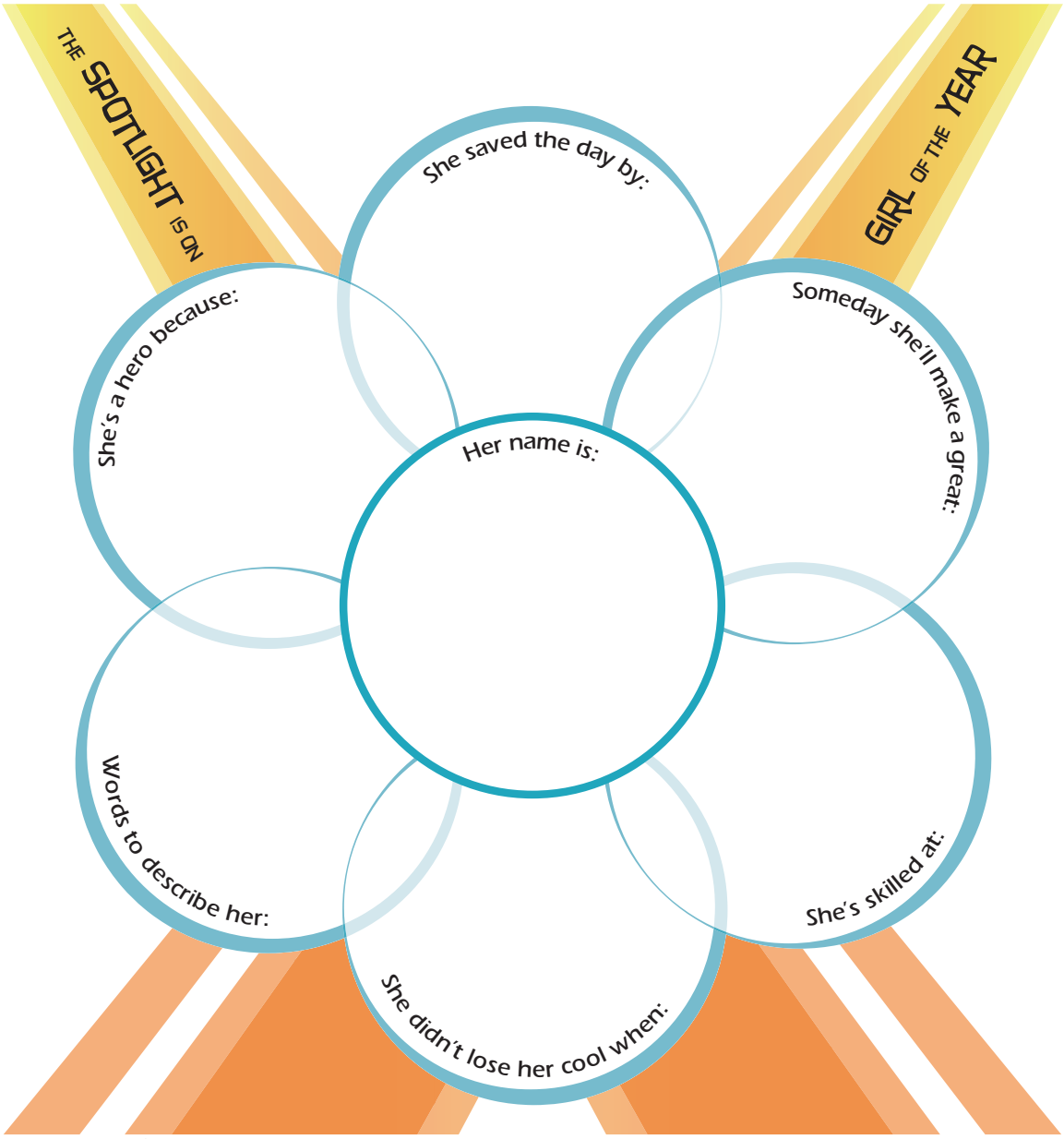
4. **Give** each girl a *Girl of the Year* praise page and have her draw her own picture in the center and write her name.

5. **Rotate** papers around the group, filling in one line or box that compliments the girl on the page. To keep girls on task and making progress, give them a set time limit. You might want to set a timer to go off when it's time to pass the paper to the next person.

6. **Return** the papers to the owners when they are complete. Allow girls a chance to read their praise page and share what was written about them. If girls are hesitant, you can start off by sharing a compliment about what you observed about their special skills and abilities as you led them through the program.

Girl of the Year Praise Page

You're safely home from the camping trip, and news of your adventures in Yellowstone has created quite a buzz around town. Everyone wants to hear your stories about the earthquake, running out of power, lack of food, and the amazing engineers you worked with. You nominate one of your *Engineers to the Rescue* group as *Girl of the Year* for your local magazine. Fill in the cover below by drawing her picture, and write some headlines complimenting her accomplishments as you've worked together in this program. Pass it around so that everyone contributes to this praise page.



Techbridge

Engineers to the Rescue